

Indian Maritime University
(A Central University, Govt. of India)
End Semester Examinations – June 2023
Programme Name: B Tech (NAOE)
Semester: VI
Subject Code: UG12T2602
Subject Name: Ship Motion and Control

Date: 01.06.2023

Max Marks: 70

Duration: 03 Hrs

Pass Marks: 35

General Instructions

- (i) All Sections (A, B & C) are to be attempted.
- (ii) Options, if any, are specified in respective section.
- (iii) Hydrodynamic charts are permitted

Section A

Ten MCQs/Fill in the Blanks of 01 Mark each – Choose the correct answer as applicable.

1. Motions with restoring effect take place in _____plane of the coordinate system.
 - (a) horizontal
 - (b) vertical
 - (c) both horizontal and vertical
 - (d) none of the above
2. According to North East Down (NED) coordinate system the following is true
 - (a) Axis towards fore is negative
 - (b) Axis towards starboard is positive
 - (c) Axis towards the keel is positive
 - (d) Clockwise rotations are negative
3. Ship encounter frequency is same as wave frequency in
 - (a) head sea
 - (b) beam sea
 - (c) following sea
 - (d) none of the above
4. The motion response is periodic with constant amplitude for _____systems
 - (a) overdamped

- (b) critically damped
 - (c) underdamped
 - (d) undamped
5. Which one of the following mathematical conditions corresponds to overdamping?
- (a) Equal and real roots
 - (b) Distinct and real roots
 - (c) Distinct and complex roots
 - (d) Roots not defined
6. The dynamic amplification factor corresponding to resonance under damping with the value damping ratio equal to 0.5 is
- (a) 0
 - (b) ∞
 - (c) 1
 - (d) Undefined
7. A ship that retains its straight-line path, course and position after the action of external disturbance is said to have _____ motion stability.
- (a) dynamic
 - (b) course
 - (c) directional
 - (d) positional
8. In captive model test the ship model is _____
- (a) held securely and moved in desired paths
 - (b) remotely operated
 - (c) exposed to open waters
 - (d) all the above
9. Following is a not a possible hydrodynamic derivative
- (a) N_{vr}
 - (b) N_{rrr}
 - (c) N_{vvv}
 - (d) N_{rrv}
10. _____ aids in turning a ship.
- (a) Directly rudder forces and moments
 - (b) Drift angle due to rudder forces and moment
 - (c) Both (a) and (b)
 - (d) Neither (a) nor (b)

Section B

Five Questions of 02 Marks each

11. Define Response Amplification Operator.
12. What are the factors affecting seakeeping performance of a ship?
13. What do controllability aspects encompass?
14. Explain K and T in Nomoto model.
15. How is a balanced rudder different from an unbalanced one?

Section C

Seven Questions of 10 Marks each of which any 05 questions to be answered.

16. Explain the method of determining added mass coefficient of a ship in heaving motions.
17. A ship of length, "L"; beam, "B" and draft, "T", is undergoing heave motions in waves. The water plane coefficient is 0.8 and block coefficient is 0.6. Assuming added mass in heave as 80% of the ship mass, calculate the circular natural frequency of the ship in heave. The density of sea water is 1025 kg/m^3 .
18. (a) With the help of a neat sketch explain the co-ordinate system used in ship maneuvering studies. Also explain clearly the drift angle and the heading angle.
(5 marks)
(b) Explain the working of the closed loop control system in ship controllability.
(5 marks)
19. Derive the maneuvering equations and motion and explain the significance of hydrodynamic derivatives.
20. Describe the various captive model testing techniques used in ship maneuverability predictions. Also indicate the hydrodynamic derivatives obtained from each test assuming a third order non-linear mathematical model.
21. Describe the following maneuvers and their IMO requirements
(a) Turning circle maneuver
(5 marks)
(b) Zig-zag maneuver
(5 marks)
22. Explain the step-by-step procedure using relevant sketches involved in steering a ship using rudder as the major control device.

